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Objective Lightning Forecasting at Kennedy Space Center/Cape Canaveral Air Force Station using Cloud-to-Ground Lightning Surveillance System Data

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The 45th Weather Squadron (45 WS) forecasters at Cape Canaveral Air Force Station (CCAFS) in Florida include a probability of thunderstorm occurrence in their daily morning briefings. This information is used by personnel involved in determining the possibility of violating Launch Commit Criteria, evaluating Flight Rules for the Space Shuttle, and daily planning for ground operation activities on Kennedy Space Center (KSC)/CCAFS. Much of the current lightning probability forecast is based on a subjective analysis of model and observational data. The forecasters requested that a lightning probability forecast tool based on statistical analysis of historical warm-season (May - September) data be developed in order to increase the objectivity of the daily thunderstorm probability forecast. The tool is a set of statistical lightning forecast equations that provide a lightning occurrence probability for the day by 1100 UTC (0700 EDT) during the warm season. This study used 15 years (1989-2003) of warm season data to develop the objective forecast equations. The local CCAFS 1000 UTC sounding was used to calculate stability parameters for equation predictors. The Cloud-to-Ground Lightning Surveillance System (CGLSS) data were used to determine lightning occurrence for each day. The CGLSS data have been found to be more reliable indicators of lightning in the area than surface observations through local informal analyses.

This work was based on the results from two earlier research projects. Everitt (1999) used surface observations and rawinsonde data to develop logistic regression equations that forecast the daily thunderstorm probability at CCAFS. The Everitt (1999) equations showed an improvement in skill over the Neumann-Pfeffer thunderstorm index (Neumann 1971), which uses multiple linear regression, and also persistence and climatology forecasts. Lericos et al. (2002) developed lightning distributions over the Florida peninsula based on specific flow regimes. The flow regimes were inferred from the average wind direction in the 1000-700 mb layer at Miami (MIA), Tampa (TBW), and Jacksonville (JAX), Florida, and the lightning data were from the National Lightning Detection Network. The results suggested that the daily flow regime may be an important predictor of lightning occurrence on KSC/CCAFS.

The 1200 UTC MIA, TBW, and JAX soundings were used in this study as in Lericos et al. (2002) to calculate the daily flow regimes. Going a step further, the probabilities of lightning occurrence based on the flow regimes were calculated using CGLSS data. These probabilities were also used as predictors in the statistical lightning forecast equations, but they were found to improve the thunderstorm forecast over persistence and climatology when used on their own. The equations were developed using the logistic regression method, as in Everitt (1999). This is the appropriate method to use when the predictand is binary, as in this case when lightning occurred (1) or not (0).

The presentation will demonstrate the equation development, show the equations and their predictors, and describe the equation performance. It will also discuss the flow regime lightning probabilities by month and their improvement in skill over persistence and climatology.

References

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